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DISEASE DETECTION SURVEY
Air Pollution

Jacob Lake Ranger District
Kaibab National Forest
Arizona

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240 W Prospect Rd
Fort Collins CO 80526

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In August 1971, Robert Loomis, plant pathologist in the Forest Service Insect and Disease Branch, examined trees and associated vegetation on the Jacob Lake Ranger District. The purpose of the survey was to make note of tree and plant condition on selected areas of the District prior to the scheduled 1974 operation of the Navajo Electrical Generating Station, located near Page, Arizona. No leaf or needle abnormalities were noted which might later be confused with symptoms of possible SO_2 injury.

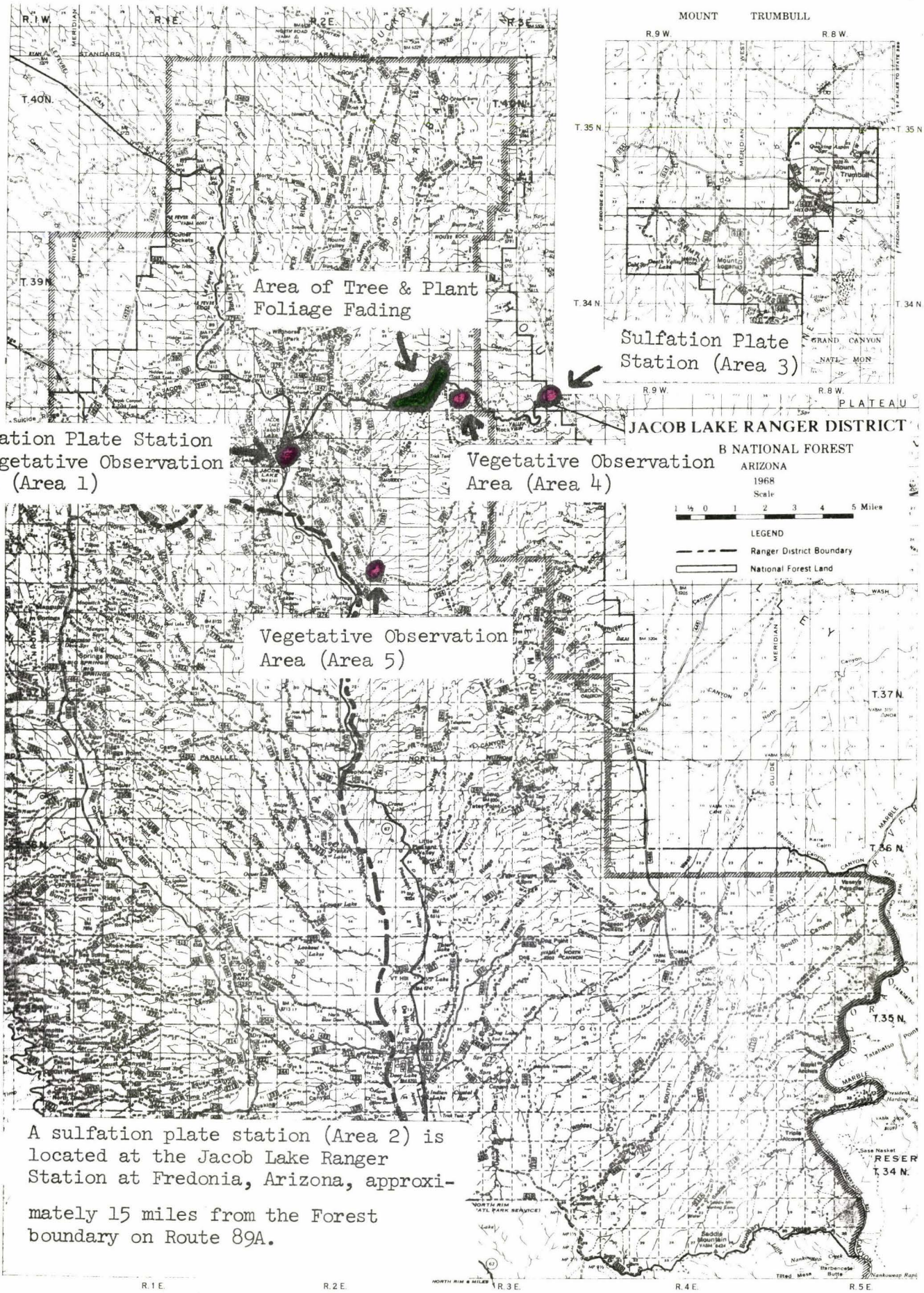
Method.--A preliminary detection system, consisting of two sulfation plate stations, was initiated in November 1970. An additional sulfation plate station and three vegetative observation areas were established in June 1971 (Figure 1). Foliage of trees and associated plants was examined for abnormalities caused by insects, diseases, and environmental factors which might later be confused with symptoms of possible SO_2 injury. In addition to examining tree and plant foliage on the established areas, foliage was examined at several other locations along Route 89A and Route 67 within the Jacob Lake Ranger District boundary (Figure 1).

Considerations for establishing observation areas include:

1. Presence of a variety of trees and associated plants growing in the area. One phase in evaluating possible SO_2 injury to plants is to determine if similar injury had occurred to a variety of plant species.1/

1/ Air Pollution Control Assoc. 1971. Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas. Jacobson, J. S., and A. C. Hill, Editors. Pittsburgh, Pa.

Figure 1



A sulfation plate station (Area 2) is located at the Jacob Lake Ranger Station at Fredonia, Arizona, approximately 15 miles from the Forest boundary on Route 89A.

2. The observation areas should have adequate soil moisture. Plants growing in areas with adequate soil moisture and high humidity are more susceptible to SO_2 injury than plants growing under arid conditions.2/

The sulfation plate stations were established in order to get some idea of background sulfation rates. This information, coupled with tree and plant condition observations, may be helpful in the future task of determining whether or not SO_2 emitted by the generating station has an adverse effect on National Forest vegetation.

Results.--The following trees and plants were examined to determine foliage condition:

Ponderosa pine (Pinus ponderosa)
White fir (Abies concolor)
Aspen (Populus tremuloides)
Gambel oak (Quercus gambelii)
Pinyon pine (Pinus edulis)
Juniper (Juniperus spp.)
Cliff rose (Cowania stansburiana)
Sagebrush (Artemisia spp.)

No symptoms caused by insects, diseases, or environmental factors were noted which might later be confused with symptoms of possible SO_2 injury. Tree and plant condition was noted as follows:

1. Fading and browning of tree and plant foliage was noticeable along Route 89A, approximately 5 miles east of Jacob Lake (Figure 1). This same symptom was also noted along 89A north of Jacob Lake, but to a lesser degree. Both old and new foliage of ponderosa pine, pinyon pine, Gambel oak, and several other shrubs and plants was affected. The cause of this injury has not been determined; however, drought or the use of salt on the road may have contributed to this problem.

2. Many juniper and pinyon trees in Area 3 appear to be declining. The foliage of several pinyon trees is confined to the twig tips which gives the tree a "tufted" appearance. Both pinyon dwarf mistletoe (Arceuthobium divaricatum), on pinyon pine, and the true mistletoe (Phoradendron juniperinum), on juniper, were found in the area.

3. In Area 1, several ponderosa pine trees are moderately to heavily infected with southwestern dwarf mistletoe (A. vaginatum subsp. cryptopodum). This parasite has caused crown-thinning and decreased vigor in the heavily infected trees.

2/ Ibid.

A needle mottle or fleck of unknown cause was noted primarily on the older ponderosa pine needles. This marking had begun to show on the current year's needles.

Sulfation plate data for the period November 1970-October 1971 are as follows:

Area 1 - Jacob Lake Ranger District

Month	Days exposed	* Sulfation rate (Micrograms $SO_3/cm^2/day$)
Nov. 1970	29	** <Detectable minimum
Dec.	49	1.9
Jan. 1971	13	<Detectable minimum
Feb.	30	<Detectable minimum
Mar.	29	1.8
Apr.	28	3.7
May	34	<Detectable minimum
Jun.	29	<Detectable minimum
Jul.	33	2.6
Aug.	29	<Detectable minimum
Sep.	29	<Detectable minimum
Oct.	28	<Detectable minimum

Area 2 - Jacob Lake Ranger District

Nov. 1970	29	<Detectable minimum
Dec.	48	2.4
Jan. 1971	14	8.3
Feb.	29	<Detectable minimum
Mar.	30	<Detectable minimum
Apr.	28	1.9
May	34	<Detectable minimum
Jun.	29	<Detectable minimum
Jul.	33	2.6
Aug.	31	1.5
Sep.	27	<Detectable minimum
Oct.	28	<Detectable minimum

* Corning Laboratories, Inc., Cedar Falls, Iowa, supplies and analyzes all sulfation plates.

** Detectable minimum for 30-day period (micrograms $SO_3/cm^2/day$)
Sep. 1970-Mar. 1971 - 1.2
Apr. 1971-Sep. 1971 - 1.0
Oct. 1971 - 0.8

Area 3 - Jacob Lake Ranger District

Month	Days exposed	* Sulfation rate (Micrograms $SO_3/cm^2/day$)
Jun. 1971	29	4.0
Jul.	32	** <Detectable minimum
Aug.	31	1.5
Sep.	27	<Detectable minimum
Oct.	28	<Detectable minimum

* Corning Laboratories, Inc., Cedar Falls, Iowa, supplies and analyzes all sulfation plates.

** Detectable minimum for 30-day period (micrograms $SO_3/cm^2/day$)
Sep. 1970-Mar. 1971 - 1.2
Apr. 1971-Sep. 1971 - 1.0
Oct. 1971 - 0.8

Discussion.--This survey is an effort to get some idea of plant condition and sulfation rate on selected areas of the Jacob Lake Ranger District prior to operation of the Navajo Generating Station. To date, the only locations we have found acute SO_2 injury to Southwestern forest vegetation have been within 4 miles of the source emitting SO_2. The Navajo Generating Station is located more than 30 miles from the District boundary, and, therefore, the possibility seems remote that SO_2 emissions from this installation will cause injury to vegetation on the Jacob Lake Ranger District. Nevertheless, the possibility that SO_2 emissions could cause acute or chronic injury to forest vegetation still exists, and, for this reason, sufficient background work should continue so that a more complete final evaluation can be made.

Note should be made of the high sulfation rate recorded on Area 2 in January 1971. There are no known sources of air pollution in or near Fredonia, Arizona, which might have caused this sulfation rate. Therefore, this apparent anomaly is probably due to variation in the individual plate or its analysis, rather than a variation in air quality.

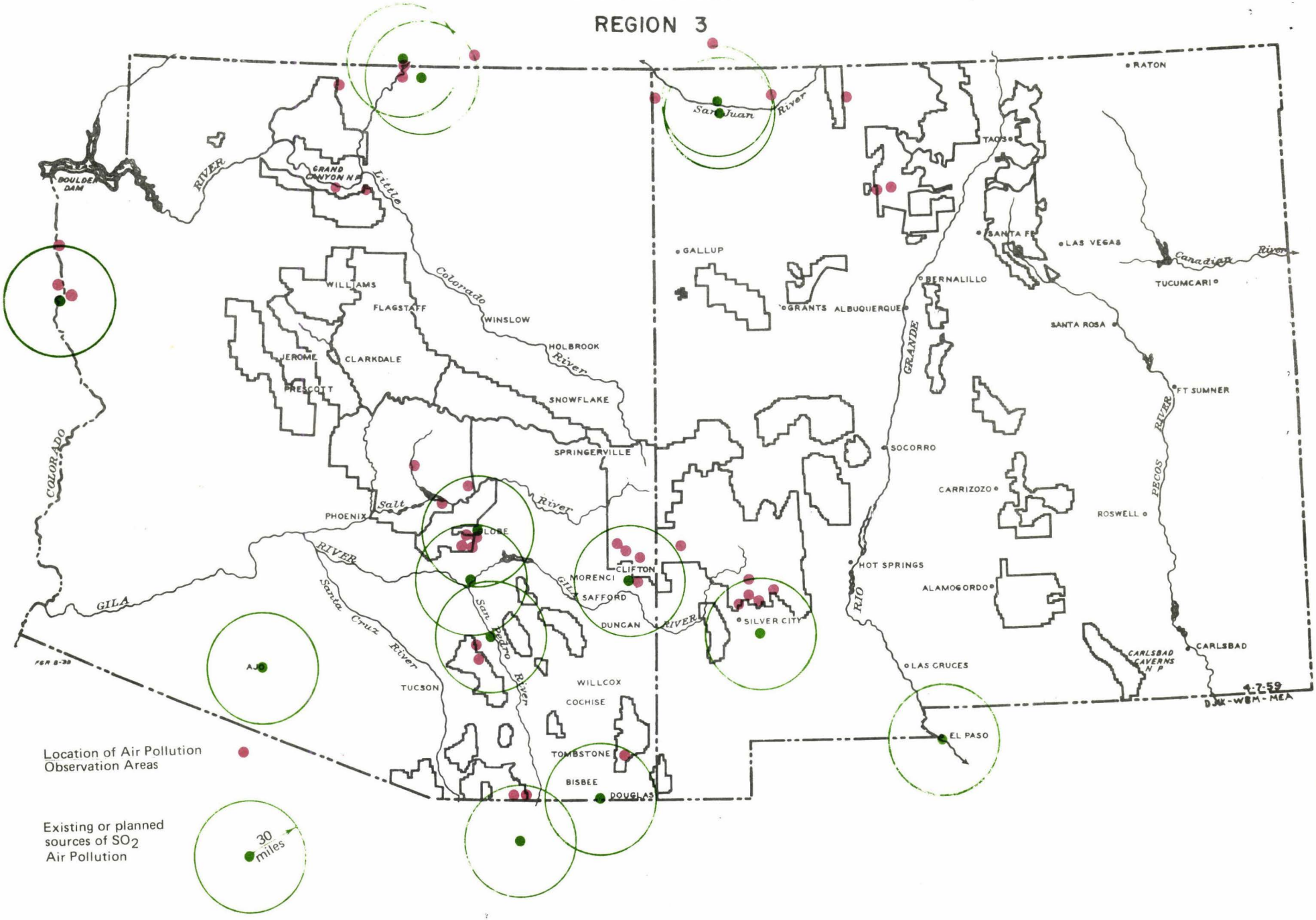
A map is attached which shows the areas included in the 1971 air pollution detection survey.

Recommendations.--

1. Conduct a detection survey on the Jacob Lake Ranger District in the summer of 1972. This survey would help to increase familiarity with normal plant condition prior to operation of the Navajo Generating Station.

2. Continue changing the sulfation plate in Area 3, monthly, at least until July 1972.

AIR POLLUTION DETECTION SURVEY - 1971
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
REGION 3



Location of Air Pollution Observation Areas

Existing or planned sources of SO_2 Air Pollution

30 miles